WEIL-McLAIN

INSTALLATION/OPERATING INSTRUCTIONS

BCP-3

Hot Water Reset Control
For up to 3 Boilers

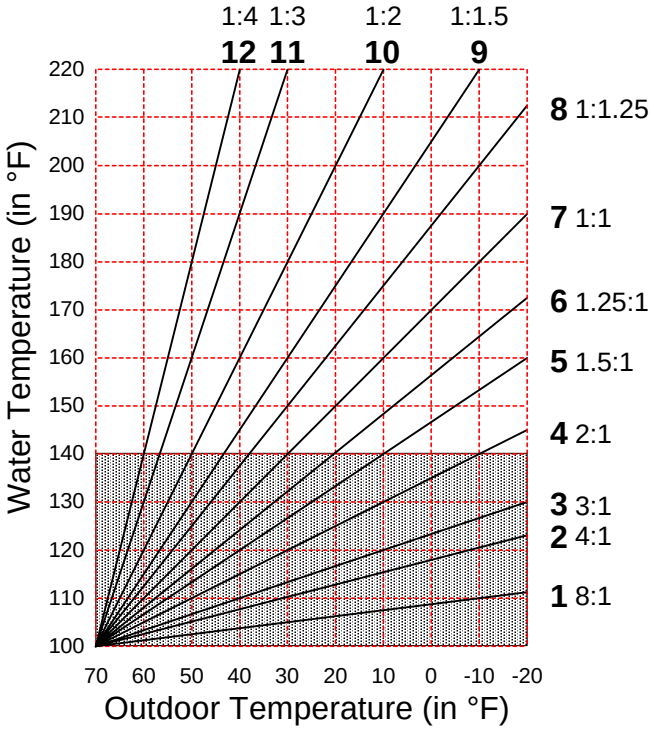
How the BCP-3 operates...

The BCP-3 establishes ambient comfort by varying the temperature of the heating system's circulating hot water in response to changes in the outdoor temperature. In addition, it provides an outdoor temperature based start/stop and system pump control for systems with less than 3 boilers.

Two sensors are used, one to monitor the outdoor temperature, and one to monitor the temperature of the circulating hot water in the heating system. When the outdoor temperature falls to the outdoor starter setting, the heating system is activated and the hot water temperature is increased proportionally to meet the need for more heat. Should it get warmer outdoors, the hot water temperature is automatically lowered by the control. If the outdoor temperature continues to rise to the outdoor starter setting then the heating system is turned off.

Because of many physical characteristics, and the type of radiation, ie. baseboard or radiant, heat loss varies. In one building, a 1-degree temperature change outdoors may require a change of 1 degree in heating water temperature; for another it may require a change of 2, 3, or even 4 degrees in order to gain the desired comfort level. This is known as the reset ratio. The middle chart shows the wide range of reset ratios available for the BCP-3.

The installer fits the BCP-3 to a specific building by adjusting the reset ratio curve. With a curve of **4** (2:1 reset ratio) a 2-degree change in outdoor temperature will change the circulating hot water temperature by 1 degree; at an **11** curve (1:3 reset ratio) an outdoor change of 1 degree will change the water temperature by 3 degrees. Most buildings with baseboard radiation require a curve of **6**, **7**, or **8**. Radiant heat applications usually require a lower curve.



An optional external heat demand input can be connected to the BCP-3 This can be connected to a new or existing thermostat or switch to shut the heating system down when the thermostat is satisfied.

The BCP-3 can control all the following types of systems: one boiler with system pump, one lo/hi fire boiler with system pump, two boilers with system pump, or three boilers (system pump output must be provided separately).

WARNING This manual must only be used by a **qualified heating installer/service technician**. Failure to comply could result in severe personal injury, death or substantial property damage.

Part Number 550-141-696/1200

DEFINITIONS

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

WARNING Indicates presence of hazard which can cause severe personal injury, death or substantial property damage if ignored.

CAUTION Indicates presence of hazard which will or can cause minor personal injury or property damage if ignored.

WARNING

The Weil-McLain BCP-3 is strictly an operating control; do not use as limit(s) or safety control(s). Each boiler must have its own certified limit and safety controls as required by codes. These controls are the responsibility of the installing contractor. He must verify proper operation and correct any safety problems before installing the BCP-3.

Failure to follow all instructions in proper order can cause severe personal injury, death or substantial property damage. Read all instructions before installing Weil-McLain BCP-3.

INSTALLATION

MOUNTING THE CONTROLLER

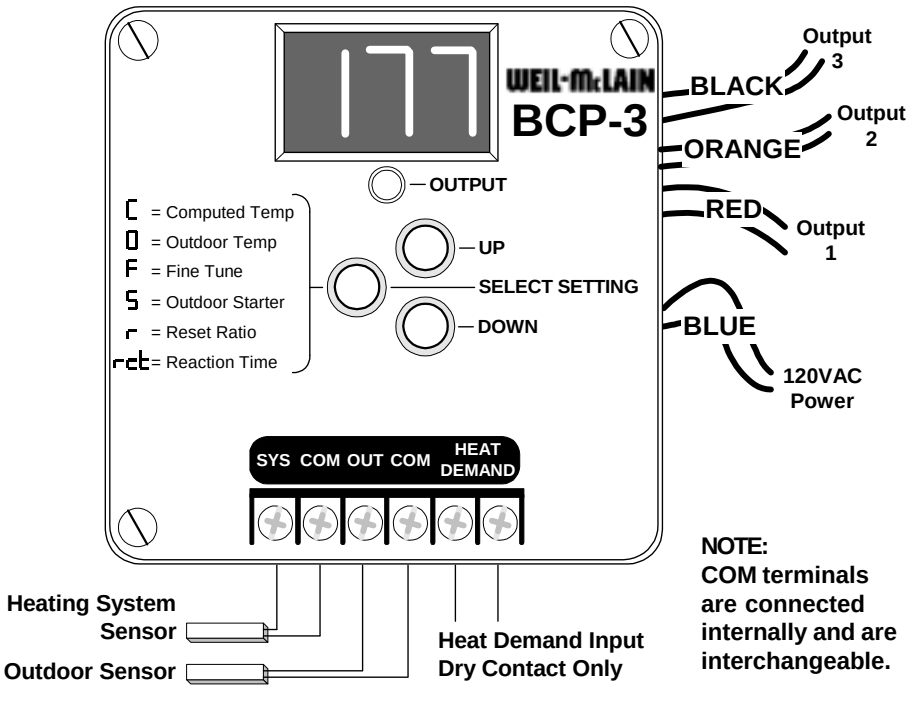
- The BCP-3 is designed to mount on a standard 1900 (4”x4”) electrical box (not supplied).
- If panel mounting, or if additional room is needed for wiring, an extension skirt is available.
- Locate the BCP-3 in a convenient location near the unit to be controlled.
- Mount the unit away from excessive heat or cold. Ambient operating temperature is from 20 to 120°F.
- After completing all the wiring connections (see below) use the two screws provided to mount the BCP-3 to the 1900 box.

INSTALL THE HEATING SYSTEM SENSOR

- The BCP-3 heating system sensor is designed to be installed in a 3/8" ID well.
- Locate the sensor in the common header, where it will register the output of all the boiler stages. If the sensor can not read the output of all the stages, the control will not be able to sequence properly.
- The sensor wires can be extended up to 500’ by splicing with 18 gauge shielded wire.
- Do not run sensor wire in conduit with line voltage.
- The sensor has no polarity. Connect either sensor wire to the front terminal marked *SYS*.
- Connect the other sensor wire and the shield (where needed) to a front terminal marked *COM*.

INSTALL THE OUTDOOR SENSOR

- Locate the sensor in the shade on the north side of the building.
- Be sure the location is away from doors, windows, exhaust fans, vents, or other possible heat sources.
- The sensor should be mounted at least 4 inches away from the building wall and approximately 10 feet above ground level.
- The sensor wires can be extended up to 500’ by splicing with 18 gauge shielded wire.
- Do not run sensor wire in conduit with line voltage.
- The sensor has no polarity. Connect either sensor wire to the front terminal marked *OUT*.
- Connect the other sensor wire and the shield (where needed) to a front terminal marked *COM*.



NOTE:
COM terminals are connected internally and are interchangeable.

WIRING THE HEAT DEMAND INPUT

- If the *HEAT DEMAND* inputs are open, the BCP-3 will not energize any output stages.
- The BCP-3 is shipped with a jumper across the *HEAT DEMAND* inputs. **DO NOT** remove this jumper unless you replace it with a dry contact switch which is closed when heat is required in the system. This type of contact is usually provided by a thermostat which activates the BCP-3 when it requires heat.
- When the *HEAT DEMAND* inputs are opened, all boiler stages are immediately turned off. If there is an active System Pump output, it will run on for three minutes, and then also turn off.
- The Heat Demand signal must be a dry contact only. No voltage can be placed across the *HEAT DEMAND* terminals.
- Bring the two wires from the dry contact to the front terminals marked *HEAT DEMAND*.

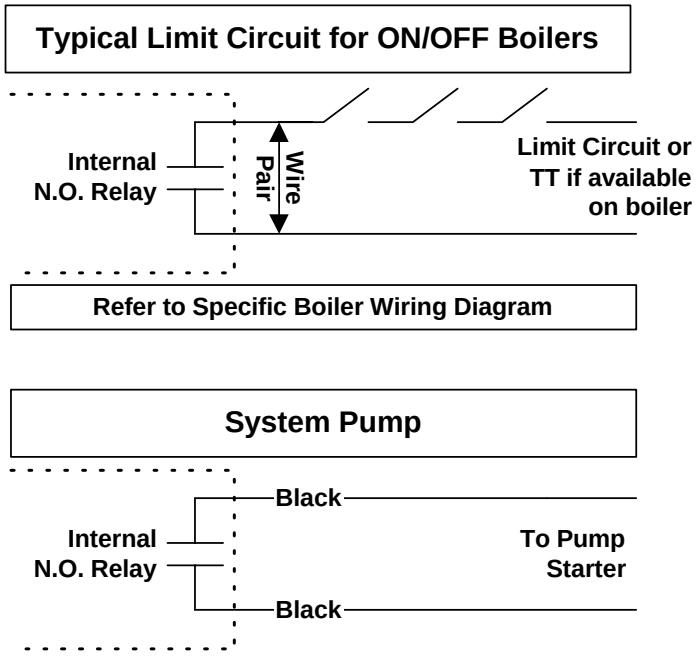
CAUTION Do not remove the factory installed Heat Demand jumper without installing a Heat Demand switch.

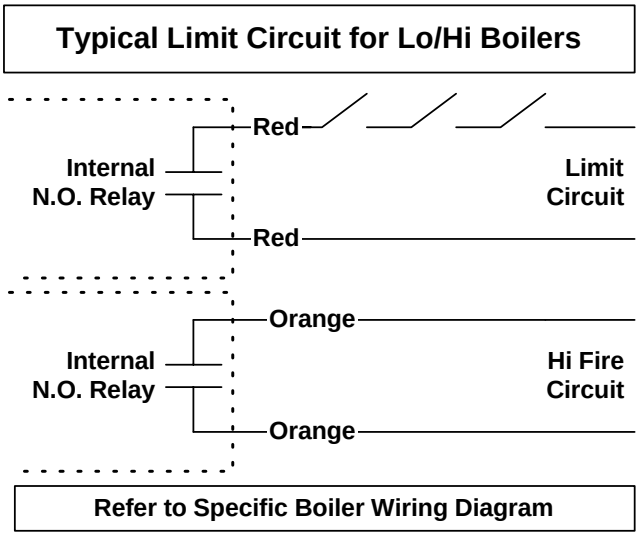
WIRING THE POWER INPUTS

- Attach 120VAC line voltage to the two blue wires extending from the back of the BCP-3.
- Use wire nuts, or wrap the connections with electrical tape.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 wiring.

WIRING THE OUTPUTS

- The output wires provide a dry contact closure only. They do not source any power.
- Each pair of same colored wires are connected internally to a N.O relay which is rated at 8 Amp max.
- Total output of all stages must not exceed 15A.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 wiring.
- For on/off (single stage) boilers, wire the appropriate pair of wires in series with the boiler's limit circuit or thermostat wire terminals (TT) as shown in the chart below.
- For lo/hi fire boilers, connect the Red output wires in series with the boiler's limit circuit. Connect the Orange output wires to the Hi fire control circuit.
- For a System Pump, connect the Black output wires to the pump starter. Note if there are three boilers, the System Pump must be energized by another controller.





SYTEM TYPE	OUTPUT 1 Red Wires	OUTPUT 2 Orange Wires	OUTPUT 3 Black Wires
1 Boiler & Pump	Boiler 1	Not connected	System Pump
2 Boilers & Pump	Boiler 1	Boiler 2	System Pump
3 Boilers	Boiler 1	Boiler 2	Boiler 3
1 Lo/Hi Boiler & Pump	Lo Fire Boiler 1	Hi Fire Boiler 1	System Pump

INITIAL CONTROL START-UP

- Whenever the BCP-3 is powered up, it will display the software version number and then the current operating parameters. Each display will remain on the screen approximately 5 seconds. If the parameters are correct, there is no need to make any adjustments.
- Once the parameters have been set for a particular application, they will be retained in memory and will not need to be reset.
- Note that if you do change an operating parameter, you will need to reset all the settings (shown on chart on next page).
- An operating parameter can only be changed when it is being displayed in the start-up sequence. To restart the sequence it is necessary to remove power to the BCP-3 and then power it again.
- Set the operating parameters as described in sequence below:

°F or *°C* - Fahrenheit or Celsius Temperature Operation **Default is °F**

- If the display shows *°F* then the BCP-3 will operate in Fahrenheit degrees.
- If the display shows *°C* then the BCP-3 will operate in Celsius degrees.
- To change the temperature operation, hold down the center button while pushing either the *UP* or *DOWN* button to toggle between the displays of *°F* and *°C*.
- When the correct temperature operation is selected, release the buttons and wait approximately 5 seconds.

b_1, *2*, *3*, or *4* - Output selection **Default is b_3**

- If the display shows *b_1* then the BCP-3 will control 1 On/Off Boiler and a System Pump.
- If the display shows *b_2* then the BCP-3 will control 2 On/Off Boilers and a System Pump.
- If the display shows *b_3* then the BCP-3 will control 3 On/Off Boilers.
- If the display shows *b_4* then the BCP-3 will control 1 Lo/Hi Boiler and a System Pump.
- To change the boiler output selection, hold down the center button while pushing either the *UP* or *DOWN* button to toggle between the displays the boiler outputs.
- When the correct boiler output is selected, release the buttons and wait approximately 5 seconds.

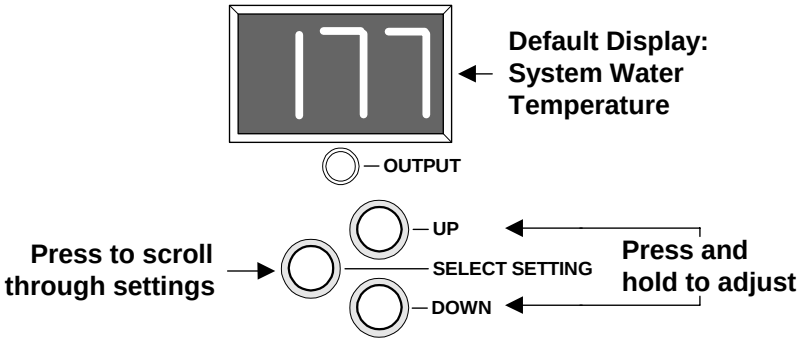
Minimum Water Temperature **Default is 140°F**

- The display will next show the minimum water temperature setting. The BCP-3 can not compute a calculated water temperature below this setting, and can not have a set point value below this.
- **DO NOT** lower this below the default setting of 140°F without contacting your Weil- McLain representative.
- To change the minimum water temperature, hold down the center button while pushing either the *UP* button to increase the value, or the *DOWN* button to decrease the value.
- When the desired minimum water temperature is selected, release the buttons and wait approximately 5 seconds.

DEFAULT SETTINGS

Settings shown in instructions have been selected by Weil-McLain and will provide proper operation for many installations.

- The BCP-3 comes equipped with default settings which are a good starting point for most installations.
- After the start-up routine has completed, the display will show the system water temperature.
- To display the other settings (see chart next page), repeatedly press the center *PRESS TO READ* button.
- A setting can only be adjusted when it is being displayed.
- Use the *UP* and *DOWN* buttons to adjust the setting.
- The display will always revert back to the actual system water temperature after 30 seconds.
- The default Fine Tune is 0°. This means the system target temperature will be 100°F at an outdoor temperature of 70°F as shown on the reset curves on the front page.
- The default Outdoor Starter setting is 60°F. When the outdoor temperature is above the Outdoor Starter setting, the BCP-3 will not give heat.
- The default Reset Ratio is curve 7 or 1:1 (see chart on first page). This ratio should be a good starting point for applications with baseboard or radiators. If the application has radiant heat, a lower numbered reset ratio curve should be selected.
- The default Reaction Time is 5 minutes. This makes the minimum run time for any stage 2 $^{1}/_{2}$ (or half the reaction time).



OPERATION

DISPLAY SETTINGS

Calculated water temperature

Center button pressed once

- This is the water temperature the BCP-3 will stage units to hold. It is based on outdoor temperature and the Fine Tune and Reset Ratio values (described in the following sections).
- The Calculated water temperature can not be less than the Minimum Water temperature setting (see opposite page).
- If either sensor is reading a fault condition, all stages will immediately turn on. The Calculated display will show *ON* to indicate this condition.
- If the outdoor temperature is above the Outdoor Starter setting, the BCP-3 will not activate stages. The Calculated display will show *OFF* to indicate this condition.
- The BCP-3 will either add stages, subtract stages, or maintain the same number of stages to hold the system temperature around the Calculated temperature.
- The Calculated temperature is the average temperature the BCP-3 will maintain. The system can be expected to fluctuate above and below this temperature. The size of the fluctuation depends on the number of stages, the size of each stage, the system load, and the Reaction Time.
- The Calculated temperature is based on all the settings described above. The temperature value can not be changed by pressing the *UP* or *DOWN* button while it is displayed.

Fine Tune **Default is 0°**

Center button pressed three times

- The Fine Tune value moves the starting point of the Reset Ratio curves (see charts on the next page).
- Therefore, any change made to the Fine Tune will immediately change the value of the Calculated water temperature by the same amount.
- For example, if the Calculated water temperature were 150°F based on the specific outdoor temperature and Reset Ratio, then increasing the Fine Tune from 0°F to 10°F would increase the Calculated water temperature to 160°F.

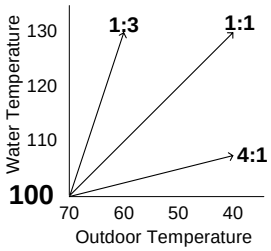
DISPLAY CHART AND ADJUSTMENTS

Press SELECT Button	DISPLAY	Press and hold either the UP or DOWN button to adjust the value
Once *	C Computed	This is the water temperature the BCP-3 will control boilers to hold. It is based on the outdoor temperature, reset ratio, and the fine tune value. If ON is shown, there is a sensor fault. If OFF is shown, there is no call for heat.
Twice *	0 Outdoor Temp	This is the outdoor sensor temperature value.
3 Times	F Fine Tune	The Fine Tune moves the reset curves vertically up or down. For example, changing the offset from 0 to -10 will decrease the water temperature 10° regardless of outdoor temperature or the reset curve selected. The Fine Tune is adjustable from -40 to 40°F.
4 Times	S Outdoor Starter	When the outdoor temperature falls below the Outdoor Starter setting, the BCP-3 will give heat. When the outdoor temperature is above the Outdoor Starter, the Calculated value will be OFF and no stages will be activated. The Outdoor Starter is adjustable from 40 to 100°F
5 Times	r Reset Ratio	The Reset Ratio controls the amount of heat which enters the heating system based on the outdoor temperature. A higher numbered Reset Ratio will result in a higher Calculated water temperature. See the chart on the first page for the reset curves. The Reset Ratio is adjustable from 1 to 12.
6 Times	rCt Reaction Time	The Reaction Time controls the minimum run time for a stage. It is adjustable from half a minute (0.5) to 8.0 minutes.
7 Times *	Default	The BCP-3 returns to the default display of actual system water temperature.

* These values can not be adjusted

- In a new installation, start with a Fine Tune value of 0°.
- Adjust the Fine Tune value in mild weather. If the ambient indoor temperatures are warm in the warm weather, decrease the Fine Tune. If the ambient building temperatures are cold in the mild weather, increase the Fine Tune.
- The rule of thumb for baseboard radiation is to change the Fine Tune by 4° for every degree you wish to change the building temperatures. For radiant heat applications, change the Fine Tune by 1° or 2° for every degree you wish to change the building temperature.
- The Fine Tune can be set from -40 to 40°F.

With a 0° Fine Tune, the ratio curves begin at 100° Water Temperature.

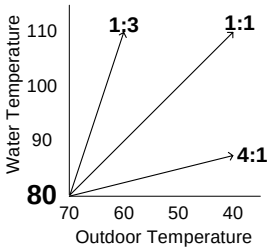


Outdoor Starter **Default is 60°F**

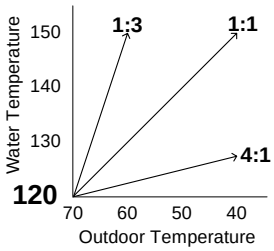
Center button pressed four times

- The Outdoor Starter sets at what outdoor temperature the BCP-3 will begin heating.
- When the outdoor temperature is above the Outdoor Starter setting, the BCP-3 will not activate stages. The Calculated water temperature will read *OFF*.
- The Outdoor Starter has a built in 2°F differential.
- When the outdoor temperature drops below the Outdoor Starter setting minus the 2°F differential, the BCP-3 will compute the Calculated water temperature and sequence stages to hold that temperature.
- If the building is too cold before the system starts, raise the Outdoor Starter temperature.
- The Outdoor Starter temperature can be set from 40 to 100°F.

With a -20° Fine Tune, the ratio curves begin at 80° Water Temperature.



With a +20° Fine Tune, the ratio curves begin at 120° Water Temperature.



Reset Ratio **Default is 7**

Center button pressed five times

- The Reset Ratio controls how much heat will be added based on outdoor temperature. The Reset Ratios are shown as Outdoor Temperature:Water Temperature.
- A 1:1 Reset Ratio signifies for each degree it gets colder outside, the Calculated water temperature will raise 1 degree.
- The other Reset Ratios are shown on the first page.
- The Reset Ratio curves start at 70°F. At 70°F the BCP-3 will require 100°F water. Note that this is not the point where the BCP-3 will begin giving heat. That point is determined by the Outdoor Starter. Also note this starting point can be changed by adjusting the Fine Tune as shown above. Finally, the Calculated water temperature can never be less than the Minimum Water temperature (see pg. 4).
- For new installations with standard baseboard heating, begin with a Reset Ratio curve of 7.
- For new installations with radiant heat, begin with a Reset Ratio curve of 4 or 5.
- Adjust the Reset Ratio value in cold weather. If the ambient indoor temperatures are cold in the cold weather, pick the next higher Reset Ratio (that is, go from 7 to 8). If the ambient building temperatures are warm in the cold weather, pick the next lower Reset Ratio.
- After adjusting the Reset Ratio curve, wait at least 24 hours before making another adjustment.
- The Reset Ratio can be set from 1 to 12.

Reaction Time **Default 2.0**

Center button pressed six times

- The Reaction Time controls the minimum run time for any stage.
- When a boiler stage has been added, that stage can not be turned off until at least half the Reaction Time has elapsed.
- The Reaction Time must be at least as long as the time it takes for a newly activated stage to start affecting the system. If the Reaction Time is shorter than this, the BCP-3 may activate additional stages before it can see the impact of each stage.
- For cast iron boilers, it is recommended to start with a Reaction Time of 5.0 minutes.
- If the system temperature tends to fluctuate rapidly above and below the Calculated water temperature, the Reaction Time may be set too short.
- If the system temperature tends to remain always below the Calculated water temperature, the Reaction Time may be set too long.
- When making a change to the Reaction Time, wait at least 5 reaction times before making another change. The system will need time to settle out.
- The Reaction Time can be set from 0.5 to 8.0 minutes.

LEAD STAGE ROTATION

- For the single boiler and lo/hi boiler operating mode, when heat is required, the first stage brought on is Output 1 (see output chart pg. 3).
- For the 2 and 3 boiler operating modes, the lead stage will rotate among the boilers to promote even wear on each unit.
- The Lead Stage will always be the first stage brought on when there is a call for output.
- As more output is needed, additional stages are added.
- When less output is needed, the additional stages are turned off in the reverse order of how they were added. For instance, if the stages were added in the sequence 1, 2, and 3, then they will be turned off in the sequence 3, 2, and finally 1.
- On power-up, the lead boiler will always be Output 1.
- The Lead Stage will rotate every 24 hours (either between Output 1 and 2 for 2 boilers, or between Output 1, 2 and 3 for 3 boilers).

OUTPUT LIGHT DISPLAY

- The red LED marked *OUTPUT* indicates when the BCP-3 is in the heating mode.
- The red LED will be off when the outdoor temperature is above the Outdoor Starter, or when the *HEAT DEMAND* input is open.
- When the outdoor temperature is below the Outdoor Starter, and the *HEAT DEMAND* input is closed, the red LED will be on.

HEAT DEMAND

- When the *HEAT DEMAND* input terminals are open, the BCP-3 will not energize any stages.
- The BCP-3 comes equipped with a factory installed jumper across the *HEAT DEMAND* terminals. **DO NOT** remove this jumper unless it is being replaced by a dry contact switch.
- This input would typically be provided by a thermostat. When the thermostat is satisfied, there is no need for heat. When the thermostat requires heat, the BCP-3 will activate and stage the Outputs to hold the required set point.
- This input can also be used as a remote stop/start for the BCP-3.
- When the *HEAT DEMAND* terminals are first opened, all active boiler outputs will immediately turned off. However, the System Pump output (not available in the 3 boiler operating mode) will continue to run on for 3 minutes before turning off.

SYSTEM PUMP OPERATION

- The System Pump output is design to continuously circulate the heating water whenever heat is required.
- The System Pump relay will energize whenever the outdoor temperature is below the Outdoor Starter temperature and the *HEAT DEMAND* input is closed.
- When either the outdoor temperature rises above the Outdoor Starter, or the *HEAT DEMAND* input is opened, the System Pump will run on for 3 more minutes. This removes heat from any boiler stages which were active and circulates it around the system.
- If the System Pump output has not been activated for 7 days (as might occur in the summer), the relay will be energized for 15 seconds to exercise the pump.
- The System Pump output not available in the 3 boiler operation mode.

TROUBLESHOOTING

No Display or Display of 888

Check the power to the BCP-3. The BCP-3 requires 120VAC power to the blue wires. Turn the power off and back on to restore display.

Actual or Outdoor Display shows OPN

Check that the wires from the sensor are continuous to the BCP-3. Then follow the procedure for Incorrect Temperature Display.

Actual or Outdoor Display shows SHT

The BCP-3 sees a short across the input terminals. Remove the wires from the input terminals. The display should change to read *OPN*. If it doesn't, the BCP-3 may be damaged.

Actual or Outdoor Display shows an Incorrect Temperature Display

Remove the wires from the input terminals. The display should change to read *OPN*. If it doesn't, the BCP-3 may be damaged. Take an ohm reading across the detached sensor wires. The ohm reading should correspond to the chart at right. If it doesn't, the sensor may be damaged.

TEMPERATURE (in degrees F)	VALUE (in Ohms)
0	42683
10	31215
20	23089
25	19939
30	17264
35	14985
40	13040
45	11374
50	9944
55	8714
60	7653
70	5941
80	4649
90	3667
100	2914
110	2332
120	1879
130	1524
140	1243
150	1021
160	842
170	699
180	583
190	489
200	412

No Heat - No Outputs - Output Light OFF

Check the outdoor temperature and Outdoor Starter readings. If the outdoor temperature is above the Outdoor Starter, the BCP-3 will not give heat. Then check the *HEAT DEMAND* terminals. If the *HEAT DEMAND* terminals are not jumped together, the BCP-3 will not give heat.

No Heat - No Outputs - Output Light ON - 3 Boiler Mode

Check if the actual water temperature is above the Calculated water temperature. If it is, wait until the actual water temperature falls or increase the Fine Tune value until the Calculated water temperature is above the actual. Stages should begin to fire.

No Heat - No Outputs - Output Light ON - All other modes

Remove any connections to the Black System Pump wires. Test for continuity across the System Pump output. If the wires are continuous, the BCP-3 is calling for the System Pump to run. Check the pump to determine why it is not circulating.

One or more of the Boiler Stages does not fire - Lo/Hi Fire mode

If the red *OUTPUT* light is not on, no stages should be firing. If the actual water temperature is above the Calculated water temperature, no stages should be firing. Otherwise, remove all connections to the Red and the Orange output wires and test for continuity. If the Red wires are continuous, the Lo fire stage should have been running. If it wasn't, check the boiler. It may be off on a boiler limit. If the Red and the Orange wires are continuous, and the Lo stage was firing, check the boiler to determine the fault with the Hi fire circuit.

One or more of the Boiler Stages does not fire - All other boiler modes

If the red *OUTPUT* light is not on, no stages should be firing. If the actual water temperature is above the Calculated water temperature, no stages should be firing. Otherwise, remember the lead stage will rotate every 24 hours. If one boiler is sufficient to hold the actual temperature at or above the Calculated water temperature, then the other boiler stages will not be active until the lead changes. If no boilers are firing, remove all connections to the output wires and check for continuity. If any set of wires were continuous, that boiler should have been firing. Check that boiler.

REPAIR PARTS

389-900-177	3/8" Brass sensor with plastic wall mount clip. This sensor can be used for either system temperature or outdoor temperature